Solitary Waves for the Maxwell-Schrodinger Equations

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In this lecture, we consider a quantistic non - relativistic charged particle (say an electron), that is moving under the action of an external force field. It generates a wave function (solution of the Schrodinger Equation) and an electromagnetic field (solution of the Maxwell Equations). We study the steady states generated by the interaction of these two fields with the external one. In particular, we consider the case of the Hydrogen atom, where the external force field is the electromagnetic one generated by the nucleus. The equations that describes this phenomenon are the coupled Maxwell-Schrodinger ones. We prove the existence of infinitely many standing waves that are rapidly decaying at infinity. Mathematically, this consists in the analysis of an eigenvalue problem for a nonlinear system of two second order elliptic equations. The main property of this system is its variational structure, namely its equations are the Euler-Lagrange ones of an Energy Functional.